

objectives and methods of his research but fails to provide the results. Those looking for an overview of the natural history of polar bears will not find it here. While not destined to be a scientific reference, the book is a readable account of polar bears in one corner of the Russian Arctic and well deserves to be added to the library of any ardent admirer of polar bears. (Andrew E. Derocher, Norsk Polarinstitut, Storgata 25, Postboks 399, N-9001 Tromsø, Norway.)

**QUATERNARY AND GLACIAL GEOLOGY.** Jürgen Ehlers. 1996. Chichester, New York, Brisbane, Toronto, and Singapore: John Wiley and Sons. xii + 578 p, illustrated, hard cover. ISBN 0-471-95576-0. £75.00.

For about a decade there was only one general text devoted to the subject of glacial geology, Drewry's *Glacial geologic processes* (now out of print). Then, Hambrey's *Glacial environments* (1994), Menzies' *Glacial environments* (two volumes, 1995 and 1996) and Bennett and Glasser's *Glacial geology: ice sheets and landforms* (1996) arrived in quick succession to widen the choice of texts for those wishing to teach and research in glacial geology and geomorphology, and in related topics such as stratigraphy, sedimentology, and palaeoenvironmental reconstruction. Now, a further text dealing with glacial geology has become available: *Quaternary and glacial geology*. This text has been translated by Philip Gibbard from *Allgemeine und historische Quartärgeologie*.

Rather than duplicating the intentions, subject matter, and scope of the three previously mentioned texts, *Quaternary and glacial geology* stands apart from them in several important ways. Not the least of these is price, which, at £75, is substantially greater than either Hambrey or Bennett and Glasser's volumes, both of which were approximately £20. On the other hand, it is immediately apparent that, at 578 pages, *Quaternary and glacial geology* is a more substantial text, 91 pages of which comprise a very comprehensive and up-to-date reference list (which probably forms a useful resource in its own right). However, the main feature distinguishing this text from the others is its broader scope, specifically its discussion of non-glacial Quaternary sedimentary and geological processes (comprising 67 pages out of 217 on general Quaternary geology), and its regional accounts of Quaternary stratigraphy and history (comprising 153 pages out of 221 on general Quaternary stratigraphy).

The text is divided into four sections: 'General Quaternary geology,' 'Quaternary deposits and landforms,' 'Quaternary stratigraphy,' and 'Perspective.' There are 213 black-and-white photos, maps and diagrams, and 12 tables. 'General Quaternary geology' commences with an introduction to the traces and causes of ice ages, including an interesting historical perspective on ice-age theories, an account of orbital theory, and brief outlines of potential terrestrial mechanisms such as continental distribution and ocean circulation, volcanism, orogeny and atmospheric circulation, and chemical weathering and CO<sub>2</sub>

drawdown. It then moves on to deal with glacier dynamics, emphasising ice-sheet formation and reconstruction. The second section deals with Quaternary deposits and landforms, with the following subsections: glacial deposits and landforms, meltwater deposits and landforms, periglacial deposits and landforms, terrestrial interglacial environments (vegetation, fauna, soils, and the impacts of human activities, the last discussing archaeological evidence), marine environment, and methods of investigating glacial and interglacial deposits. The last subsection deals with biological remains (macroscopic plant remains, pollen and spores, diatoms, mammals, molluscs, beetles, foraminifera, and ostracods) in addition to sedimentary morphology and mineralogy.

Section III deals with Quaternary stratigraphy, with the following subsections: principles of stratigraphy (including chronostratigraphy, lithostratigraphy, and biostratigraphy) and dating Quaternary deposits (oxygen isotopes, magnetostratigraphy, radiocarbon, potassium/argon, thorium/uranium and fission-track dating, thermoluminescence, optical-stimulated luminescence and electron-spin resonance, beryllium and amino-acid dating, and varves). The section then deals with regional Quaternary histories: Quaternary stratigraphy of northern Europe, Quaternary history of the Alps, Quaternary history of North America, Quaternary history of the rivers (Danube, Rhine, Thames, Mississippi, those in Siberia, and general Holocene (postglacial) fluvial development), and loess stratigraphy. The final section provides a concise overview of the entire volume and a brief concluding statement on future research directions. The conclusion stresses the continuity of Quaternary processes with current and future environmental change: 'Quaternary research does not deal with a random period of the Earth's history but with the period in which we live...Because of strong anthropogenic alteration of the atmospheric composition during the last 100 years questions about the impact of those changes on climate and sea level have focused current investigations. A considerable contribution to answering these questions must come from Quaternary research' (page 455).

Some minor specific shortcomings can be identified, for instance the erroneous suggestion that ice shelves are present in Spitsbergen, and, more substantially, a lack of references in the discussion of ice sheets to the current, lively, and important debate on the stability of the East Antarctic ice sheet, which subsumes evidence from a variety of Quaternary disciplines (for example, Barrett and others 1992; Sugden and others 1993). In places, the text betrays its origins as a translation with some awkward constructions, but this is not a significant distraction as it remains readable throughout, surely something of an achievement for a relatively specialised, translated text.

On the whole, *Quaternary and glacial geology* has as much in common with texts such as Lowe and Walker's *Reconstructing Quaternary environments* (1984), Dawson's *Ice age Earth* (1992), and Williams, Dunkerley, De Deckker, Kershaw, and Stokes' *Quaternary environ-*

ments (1993), as with the more specifically glacially orientated *Glacial environments* (either Hambrey or Menzies) or *Glacial geology: ice sheets and landforms*. The aims and intended audience for this text are not stated explicitly, which makes it difficult to judge how well the volume actually fulfils its intentions. It seems that comprehensive use of *Quaternary and glacial geology* is likely to be made by those at the advanced undergraduate stage onwards. Although accessible enough to be dipped into for an introduction to general Quaternary and glacial geology, the text's intimidating size will probably reduce the extent to which it is employed for such a purpose. However, it should prove a useful resource for final honours courses or modules in Quaternary environments, with its high level of detail and regional case studies, the latter in particular meeting a requirement that might otherwise have to be served by a meticulous literature synthesis from specialist journals. Postgraduates will certainly find this a useful text for similar reasons.

In summary, *Quaternary and glacial geology* is to be commended, along with both its author and translator, for providing a lucid text that moves smoothly from an introductory to an advanced level of detail, and backs up its treatment of theory and technique with regional studies comprising more than a quarter of the volume. This treatment is probably as good a combination of breadth and depth achievable without resorting to very specialised texts, such as edited, multi-author volumes or conference proceedings, which tend to be less coherent. (Richard Hodgkins, Department of Geography, University of Bristol, Bristol BS8 1SS.)

### References

- Barrett, P.J., C.J. Adams, C.J. McIntosh, C.C. Swisher III, and G.S. Wilson. 1992. Geochronological evidence supporting Antarctic deglaciation three million years ago. *Nature* 359: 816–818.
- Sugden, D.E., D.R. Marchant, and G.H. Denton. 1993. The case for a stable East Antarctic ice sheet. *Geografiska Annaler* 75A (4): 151–154.

**THE POLAR REGIONS AND THE DEVELOPMENT OF INTERNATIONAL LAW.** Donald R. Rothwell. 1996. Cambridge: Cambridge University Press. xxxii + 498 p, hard cover. ISBN 0-521-56182-5. £60.00; \$US95.00.

Lawyers are instinctively drawn to distinguishing between apparently similar circumstances, and finding similarities between apparently different ones. Instinct could not be better satisfied than by the polar regions, considered together rather than separately: how similar are the Arctic and Antarctic to each other, and how different? And, either together or separately, how different are they from the rest of the world, and how similar? These are the basic questions that, in the perspective of international law and relations, drive the book under review.

The author, a senior lecturer in the Faculty of Law at the University of Sydney, begins his study with an introductory summary of the geophysical and environmental char-

acteristics of the polar regions (pages 3–47). This survey is as well done as it is essential — law is heavily dependent on the circumstances to which it has to be applied, and any examination of the legal aspects of the polar regions requires an awareness of their very particular physical characteristics.

But a geographical problem has to be faced at the outset: what is 'Antarctica' or 'the Arctic'? What are their boundaries? Antarctica is easier to deal with: it is an ice-covered continental land mass clearly separated from neighbouring land masses, and certain already existing lines offer a choice — the Antarctic Circle, the Antarctic Treaty line (60°S), the true line of the ecologically significant 'Antarctic convergence' (varying between about 50° and 60°S), and the stylised version of that line adopted for CCAMLR (60°S, but 'stepped' to the north in certain areas as far as 45°S). It is this last line that the author adopts for his immediate purposes. In the Arctic, however, the situation is much more complex. Not only is there no Arctic continental land mass underpinning the polar ice, but there is no clear separation between the polar ice and neighbouring continents: furthermore, the disposition of surface land around the globe places much more of it closer to the North Pole than to the South Pole. So, while the 60°S parallel includes in Antarctica all of that continent and no part of any other, the equivalent 60°N parallel includes not only the core Arctic area but also Greenland (except for the southernmost tip), all of Iceland, most of Norway and Sweden, all of Finland, a large swathe across northern Russia, most of Alaska, and a substantial part of northern Canada. Yet it is that 60°N line that the author adopts for the purpose of his study (page 24). There must be a serious question (which deserves more than the page and a bit devoted to it) of how useful such a limit for the Arctic can really be, particularly since the author, understandably, pays scant attention to the populated areas thereby brought within his definition, in practice concentrating instead on the core polar area of ice-covered seas and immediately adjacent frozen lands.

About half the book (pages 51–257) is devoted to an account of the existing legal arrangements governing the two polar regions. The author's survey is thoroughly sound, and is to be highly recommended. He brings out clearly the extent to which the Antarctic regime is now well established while that for the Arctic is still embryonic, and the degree to which even the Antarctic region is essentially soft-centred — an enterprise of regular (now annual) plenary meetings, and wide-ranging activity and regulatory authority, but with no permanent headquarters or secretariat. He rightly observes (page 109) that nevertheless 'the [Antarctic] Treaty has been a successful framework instrument for the management of Antarctic affairs,' but that to 'understand the Antarctic legal regime it is necessary to look at not only the Treaty but the ATS [Antarctic Treaty System].' He does both, examining first the Treaty's origins and provisions (pages 51–109), and then (pages 110–154) the principal instruments that have